UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/904,129	07/11/2001	Tetsuzo Ueda	53074-025	1689

7590 10/23/2002

Michael E. Fogarty
MCDERMOTT, WILL & EMERY
600 13th Street, N.W.
Washington, DC 20005-3096

EXAMINER	
SONG, MATTHEW J	
ART UNIT	PAPER NUMBER
1765	

DATE MAILED: 10/23/2002

8

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	09/904,129	UEDA, TETSUZO
	Examiner	Art Unit
	Matthew J Song	1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *16-43* is/are pending in the application.

4a) Of the above claim(s) *21,22 and 26-30* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *16-20,23-25 and 31-43* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *11 July 2001* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of Species in Paper No. 7 is acknowledged.

2. Claims 21-22 and 26-30 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in Paper No. 7.

Claim Objections

3. Claim 33 is objected to because of the following informalities: Claim 33 is dependent on a non-elected claim. Appropriate correction is required.

4. Claims 34-43 are objected to because of the following informalities: Claim 34 recites "spreading a liquid comprising group III elements and nitrogen on a substrate; coating the substrate with a thin film comprising metal elements and oxygen" is not described in the instant specification. The claimed subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention is required. Appropriate correction is required.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it

> pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

6. Claims 34-43 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claim 34 recites "spreading a liquid comprising group III elements and nitrogen on a substrate; coating the substrate with a thin film comprising metal elements and oxygen". Coating a substrate with a thin film comprising metal elements and oxygen cannot be formed from a liquid comprising group III elements and nitrogen.

7. Claims 25 and 43 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Applicant in claims 25 and 43, the limitation of "an alloy film is grown by sequential combination of more than two growth methods", the instant specification fails to support this limitation.

8. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

9. Claim 16 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the

invention. Claim 16 recites the limitation of "spinning at certain rotation speeds" in line 4; the term "certain" is indefinite.

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

11. Claim 16-18 and 24-25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hanaoka et al (US 5,804,839) in view of Agostinelli et al (US 4,833,103).

Hanaoka et al discloses a method of forming a III-V nitride compound semiconductor device, note entire reference, where a AlN buffer layer **42** is formed on a SiC substrate **41** by MOCVD to a thickness of 30 nm at a substrate temperature of 1050°C and on the AlN buffer layer is formed by MOCVD a n-type GaN layer **13**, n-type AlGaN layer **14**, InGaN:Zn layer **15**, a p-type AlGaN layer **16** and a p-type GaN layer **17**. Hanaoka et al also discloses a p-type GaN layer **18** formed by molecular beam epitaxy (Example 2).

Hanaoka et al discloses all of the limitations of claim 16, except spreading a liquid comprising group III elements and nitrogen on a substrate and coating the substrate with a thin film comprising group III elements and nitrogen by spinning at certain rotation speeds.

In a method of depositing a III-V layer on a substrate, note entire reference, Agostinelli et al teaches applying a precursor of a III-V compound, where the preferred group III elements are boron, aluminum, indium or gallium and the preferred group V elements are nitrogen,

phosphorous and arsenic (col 6, ln 1-65) to a SiC substrate (col 5, ln 1-67). Agostinelli et al also teaches spin coating by applying a small amount of coating composition to the substrate and rotating the substrate (col 9, ln 1-67). Agostinelli et al also teaches heating the substrate and coating to a temperature above 200°C in an inert or reducing atmosphere, such as nitrogen, argon, hydrogen or mixtures of these or similar gases (col 10, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Hanaoka et al with Agostinelli et al because lower processing temperatures are required, which reduces operating costs (col 3, ln 35-65).

Referring to claim 17, the combination of Hanaoka et al and Agostinelli et al teaches annealing in a nitrogen atmosphere.

Referring to claim 18, the combination of Hanaoka et al and Agostinelli et al forming a buffer layer by spinning and annealing, thereafter forming subsequent layers on the buffer layer.

Referring to claim 24-25, the combination of Hanaoka et al and Agostinelli et al teaches forming layers by MOVCD and a forming a layer **18** by molecular beam epitaxy, the examiner interprets this to read on claim 25 as two methods of film deposition in sequence.

12. Claims 16-18, 31-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nishio et al (US 5,786,606) in view of Agostinelli et al (US 4,833,103).

Nishio et al discloses a silicon substrate with a silicon-carbide surface layer thereon grown by MOCVD at a temperature of 600°C (col 4, ln 1-67 and Example 1) and AlGaN buffer layer, thereon by MOCVD and growing an n-type GaN layer on the buffer layer, note entire reference.

Nishio et al discloses all of the limitations of claim 16, except spreading a liquid comprising group III elements and nitrogen on a substrate and coating the substrate with a thin film comprising group III elements and nitrogen by spinning at certain rotation speeds.

In a method of depositing a III-V layer on a substrate, note entire reference, Agostinelli et al teaches applying a precursor of a III-V compound, where the preferred group III elements are boron, aluminum, indium or gallium and the preferred group V elements are nitrogen, phosphorous and arsenic (col 6, ln 1-65) to a SiC substrate (col 5, ln 1-67). Agostinelli et al also teaches spin coating by applying a small amount of coating composition to the substrate and rotating the substrate (col 9, ln 1-67). Agostinelli et al also teaches heating the substrate and coating to a temperature above 200°C in an inert or reducing atmosphere, such as nitrogen, argon, hydrogen or mixtures of these or similar gases (col 10, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Nishio et al with Agostinelli et al because lower processing temperatures are required, which reduces operating costs (col 3, ln 35-65).

13. Claims 16-18 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Furushima (US 5,815,520) in view of Agostinelli et al (US 4,833,103).

Furushima discloses a ZnO, zinc oxide, epitaxial layer on a silicon substrate **9** and forming a III-V, an InGaAlN, buffer layer **10** thereon and forming a III-V n-type cladding layer **4** on the buffer layer, where the layers are formed by MOCVD at a temperature of 1000°C, note entire reference.

Furushima discloses all of the limitations of claim 16, except spreading a liquid comprising group III elements and nitrogen on a substrate and coating the substrate with a thin film comprising group III elements and nitrogen by spinning at certain rotation speeds.

In a method of depositing a III-V layer on a substrate, note entire reference, Agostinelli et al teaches applying a precursor of a III-V compound, where the preferred group III elements are boron, aluminum, indium or gallium and the preferred group V elements are nitrogen, phosphorous and arsenic (col 6, ln 1-65) to a SiC substrate (col 5, ln 1-67). Agostinelli et al also teaches spin coating by applying a small amount of coating composition to the substrate and rotating the substrate (col 9, ln 1-67). Agostinelli et al also teaches heating the substrate and coating to a temperature above 200°C in an inert or reducing atmosphere, such as nitrogen, argon, hydrogen or mixtures of these or similar gases (col 10, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Furushima with Agostinelli et al because lower processing temperatures are required, which reduces operating costs (col 3, ln 35-65).

Referring to claim 33, the combination of Furushima and Agostinelli et al teaches a Si substrate with a ZnO coating.

14. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hanaoka et al (US 5,804,839) or Furushima (US 5,815,520) or Nishio et al (US 5,786,606) in view of Agostinelli et al (US 4,833,103) as applied to claims 16-18 above, and further in view of Narumi et al (US 4,990,323).

The combination of Hanaoka et al and Agostinelli et al or the combination of Furushima and Agostinelli et al or the combination of Nishio et al and Agostinelli et al teaches all of the limitation of claim 19, as discussed previously, except the gas atmosphere comprises ammonia.

In a method of treating a semiconductor material, Narumi et al teaches a heat treatment performed in a current of a reducing gas such as, hydrogen, carbon monoxide or ammonia or a mixed gas consisting of a reducing gas and an inert gas such as nitrogen or argon (col 3, ln 1-40). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Hanaoka et al and Agostinelli et al or the combination of Furushima and Agostinelli et al or the combination of Nishio et al and Agostinelli et al with Narumi et al because ammonia is a known equivalent to a reducing gas and substitution of a known equivalent for the same purpose is obvious (MPEP 2144.06).

15. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hanaoka et al (US 5,804,839) or Furushima (US 5,815,520) or Nishio et al (US 5,786,606) in view of Agostinelli et al (US 4,833,103) as applied to claims 16-18 above, and further in view of Iacoponi et al (US 6,048,790).

The combination of Hanaoka et al and Agostinelli et al or the combination of Furushima and Agostinelli et al or the combination of Nishio et al and Agostinelli et al teaches all of the limitation of claim 19, as discussed previously, except the gas atmosphere comprises radical nitrogen atoms.

In a deposition of a thin film using a reducing ambient, Iacoponi et al teaches a reducing ambient of hydrogen gas, nitrogen gas or reactive nitrogen such as plasma, i.e. radical nitrogen

atoms (col 5, ln 1-65). Iacoponi et al also teaches a reactive nitrogen plasma may be sufficiently reducing without heating of the substrate (col 5, ln 15-30). It would have been obvious to a person of ordinary skill in the art at the time of the invention the combination of Hanaoka et al and Agostinelli et al or the combination of Furushima and Agostinelli et al or the combination of Nishio et al and Agostinelli et al with Iacoponi et al because radical nitrogen is a known equivalent to a reducing gas and substitution of a known equivalent for the same purpose is obvious (MPEP 2144.06) and a reducing ambient can be produced without heating, which reduces operating costs.

16. Claim 34-36 and 38-42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Furushima (US 5,815,520) in view of Ito et al (US 5,699,035).

Furushima discloses a ZnO epitaxial layer buffer layer **2** on a sapphire **1** or silicon **9** substrate and a InGaAlN buffer layer **3** and an n-type InGaAlN cladding layer **4** grown on the ZnO layer, where the layers are formed by MOCVD, metal organic chemical vapor deposition, to form a pn junction, note entire reference.

Furushima does not discloses spreading a liquid comprising metal elements and oxygen on a substrate and coating the substrate with a thin film by spinning at certain rotation speeds, as interpreted by the examiner.

In a method of forming a ZnO thin film, note entire reference, Ito et al teaches a conventional spin coating, where an eyedropper is used to deposit a precursor solution with excess liquid being removed through the rotation yielding a solid metal oxide layer on to a silicon substrate or sapphire substrate (col 5, ln 1-40 and col 3, ln 40-60). Ito et al also teaches a

precursor solution of metal alkoxides i.e. a liquid comprising metal and oxygen (col 4, ln 20-65). Ito et al also teaches annealing a metal oxide residue in an oxygen environment (col 5, ln 45-67 and Example 4). Ito et al also teaches ZnO layer with a grain size of less than 300 nm (col 2, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Furushima with Ito et al to form a ZnO layer with improved crystallinity, thereby improving the crystallinity of layers grown thereon (col 2, ln 25-55).

Referring to claim 35-36 and 38, the combination of Furushima and Ito et al teaches annealing a ZnO layer in oxygen prior to forming additional layers.

Referring to claim 37, the combination of Furushima and Ito et al teaches an oxygen environment. The combination of Furushima and Ito et al does not teach a H_2O gas atmosphere. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Furushima and Ito et al by using a H_2O atmosphere because H_2O is a known equivalent to oxygen as a oxygen environment and substitution of a known equivalent for the same purpose is obvious (MPEP 2144.06)

Referring to claim 39-40, the combination of Furushima and Ito et al teaches from a zinc oxide layer on a Si or sapphire substrate.

Referring to claim 41, the combination of Furushima and Ito et al teaches forming a pn junction.

Referring to claim 42, the combination of Furushima and Ito et al teaches a MOCVD process.

17. Claim 37 is rejected under 35 U.S.C. 103(a) as being unpatentable over Furushima (US 5,815,520) in view of Ito et al (US 5,699,035) as applied to claims 34-36 above, and further in view of Hofmann et al (US 4,784,975).

The combination of Furushima and Ito et al teaches all of the limitations of claim 37, as discussed previously, except the atmosphere comprises H_2O.

In a method of annealing, note entire reference, Hofmann et al teaches annealing in an ambient that contains an oxygen containing gaseous species, where suitable oxygen containing species include oxygen and H_2O (col 3, ln 50-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Furushima and Ito et al because H_2O is a known equivalent to oxygen as an oxygen atmosphere and substitution of a known equivalent for the same purpose is obvious (MPEP 2144.06).

18. Claim 43 is rejected under 35 U.S.C. 103(a) as being unpatentable over Furushima (US 5,815,520) in view of Ito et al (US 5,699,035) as applied to claims 34-36 and 38-42 above, and further in view of Hanaoka et al (US 5,804,839).

The combination of Furushima and Ito et al teaches all of the limitations of claim 43, as discusses previously, except the alloy film is grown by a sequential combination of more than two growth methods selected from the group consisting of MOCVD, MBE and hydride phase epitaxy.

Hanaoka et al teaches a method of forming a III-V nitride compound semiconductor device, note entire reference, where a AlN buffer layer **42** is formed on a SiC substrate **41** by MOCVD to a thickness of 30 nm at a substrate temperature of 1050°C and on the AlN buffer

layer is formed by MOCVD a n-type GaN layer **13**, a n-type AlGaN layer **14**, a InGaN:Zn layer **15**, a p-type AlGaN layer **16** and a p-type GaN layer **17**. Hanaoka et al also teaches a p-type GaN layer **18** formed by molecular beam epitaxy at a temperature between 150°C and 400°C (Example 2), this is interpreted to read on applicant's limitation of a sequential combination of two growth methods. Hanaoka et al also teaches a p-type GaN layer **18** formed by MOCVD at a temperature between 350° and 600°C (Example 1). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Furushima and Ito et al with Hanaoka et al because MBE operates at a lower temperature, thereby reducing operating costs.

Conclusion

19. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 703-305-4953. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin L Utech can be reached on 703-308-3868. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Matthew J Song
Examiner
Art Unit 1765

MJS
October 21, 2002

BENJAMIN L. UTECH
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700